Plant-Mycorrhizal-Decomposer Interactions and Their Impacts on Terrestrial Biogeochemistry

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Project Goals: We aim to determine the role of plant and soil resources in shaping interactions between coniferous plants, symbiotic ectomycorrhizal fungi, and free living saprotrophs, which control the biogeochemistry of forest soils.

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Interactions between soil microbes can drastically alter ecosystem processes both above and belowground, but the mechanisms by which these microbes interact, and their impacts on soil biogeochemistry remain elusive and difficult to parameterize in existing ecosystem models. We aimed to characterize interactions between coniferous plants, their major root fungal symbionts (ectomycorrhizal fungi, EMF), and free-living saprotrophic decomposers (SAPs) in soil. We performed a greenhouse-based synthetic ecosystem experiment with *Pinus taeda* seedlings growing with and without their EMF symbiont (*Suillus cothurnatus*), under high and low levels of soil carbon (C), soil nitrogen (N), and plant C (ambient vs. elevated carbon dioxide -CO_2). We expected that under low soil C, EMF prime decomposer activity and increase the release of soil C as CO_2, while under high soil C, EMF slow decomposition and reduce soil CO_2 release, with EMF competing with SAPs for access to soil organic matter (i.e. the Gadgil effect). These processes would be exacerbated under high plant C availability to EMF, but suppressed under high soil N. We found that EMF prime decay of soil organic matter under low soil C, but slow decay under high soil C. Elevated soil N suppressed the EMF effect on soil C-derived CO_2 losses. Elevated CO_2 might increase plant-EMF uptake of soil N by outcompeting SAPs, but total N uptake may depend on soil C availability. Together, our results suggest that the direction of EMF-SAP interactions is highly dependent on soil C and N availability to SAPs and might change according to plant C level.

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